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(54) IMPREGNATING AND/OR SEALING METAL CASTINGS

(71) We, DEUTSCHE GOLD-UND SILBER SCHEIDEANSTALT VORMALS ROESSLER, a Body Corporate organised under the Laws of Germany, of 9, Weissfrauenstrasse, 6000 Frankfurt Main, Germany, and BUTTNER-SCHILDE-HAAS AKTIENGESELLSCHAFT, a Body Corporate organised under the Laws of Germany of 29, Parkstrasse, 415 Krefeld, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for impregnating and/or sealing metal castings.

It is known that the pores of metal objects can be sealed by introducing a sealing compound into the pores and hardening the compound in the pores under the effect of elevated temperatures and/or catalysts. After hardening, substantially all the pores and other pervious areas in the metal objects are sealed by the sealing compound present in them so that they are less pervious to liquids and gases than previously. The sealing compound can be introduced under reduced pressure and/or pressure. For example, the objects to be treated are first of all cleaned by treatment with a solvent. After the solvent has been removed, the objects to be sealed are placed in an evacuable container, for example in the form of a tank, and the container evacuated. In a second stage, the sealing compound is allowed to flow into the container until the objects are completely covered by the liquid. The sealing compound penetrates into the pores and other pervious areas. On completion of filling, the surfaces of the objects are cleaned by washing which is followed by hardening.

Hitherto, drying oils, dissolved synthetic resins and styrene together with unsaturated fatty acids have generally been used as the sealing compounds. Since hardening of these sealing compounds is accompanied by evaporation, it has not been possible to obtain a perfect seal. Nor does the use of mixtures of styrene and polyesters provide a perfect seal because mixtures of this kind have a very short pot life and because of its high velocity excess impregnant can only be removed from the surface by means of solvents with the result that some of the resin inside the pores is dissolved out by the solvents, and the sealing effect is impaired.

Finally, low viscosity mixtures consisting for example of an unsaturated polyester and a polymerisable monomeric compound containing a $CH_2=CH$ group, have also been used for this purpose. Mixtures of this kind are thermally and/or catalytically hardened (United States Patent Specification 2,772,185).

A disadvantage of this process is that the viscosity of the material which is between about 100 and 3000cP and is attributable to the polymeric components in the polyesters, is still undesirably high for satisfactory impregnation, especially of less pervious areas. In practice, this is reflected in a fairly large number of rejects. Another disadvantage is the relatively high vapour pressure of the monomers which results in losses through evaporation both during impregnation and during hardening. In addition, elaborate safety precautions have to be taken because the monomers used are toxic and have a low flash point. Yet another disadvantage is that, on account of its high vapour pressure, the sealing compound has to be introduced by a two-stage process. In the first stage, the metal components are vigorously evacuated which has to be done at an ambient temperature at which the monomer itself would boil. In the

second stage, the evacuated components are impregnated.

A further disadvantage is that an emulsifier has to be incorporated into the polyester to enable the highly adherent impregnating resin to be subsequently washed away with water.

The present invention provides a process for impregnating and/or sealing metal castings which comprises introducing a liquid monomeric ester of a polyhydric alcohol completely esterified with methacrylic acid or acrylic acid or a mixture of such esters into the pores of the casting and hardening the ester or esters by heating in the absence of a polymerisation catalyst.

In the practical application of the process according to the invention, the articles to be treated can be directly immersed in the liquid ester(s) of methacrylic acid and/or acrylic acid and penetration of the ester(s) into the pores or into other pervious areas may be promoted by applying a vacuum or by applying pressure. These two measures may also be applied in combination with one another, in other words reduced pressure and pressure can be applied either successively or repeatedly in alternation.

However, the articles to be treated can also be introduced into an evacuable zone, this zone evacuated and, on completion of evacuation, filled with the liquid ester(s) of methacrylic acid and/or acrylic acid. After filling, the monomer(s) are removed from the surfaces of the articles which can be done for example simply by washing the articles with water to which an external emulsifier has been added. The rinsed components are then exposed to an elevated temperature of from 70 to 180°C, thus hardening the monomers inside the components.

The components thus obtained are distinguished by a particularly high degree of impermeability despite the simplified manufacturing process.

The process according to the invention can be applied to any porous metals, in particular to aluminium and magnesium casting or magnesium pressure castings. Further examples include the standard alloys of these two metals with the usual additions of other metals, for example Duralumin (Al-Cu-Mg) (Duralumin is a Trade Mark), Silumin (Si-Mg) or even metal bronzes.

Of the esters of methacrylic acid, triethylene glycol dimethacrylate is preferred. Further examples include diethylene glycol dimethacrylate, monoethylene glycol dimethacrylate, neopentyl glycol dimethacrylate, butane-diol dimethacrylate, pentaerythritol tetramethacrylate, also the corresponding acrylates, tetramethylene diacrylate and ethylene diacrylate as well as their mixtures.

Since the process is carried out in the absence of a polymerisation catalyst, the monomers can be stored for prolonged periods. In this way, it is possible simultaneously to treat a number of components in large containers, for example in tanks. In order further to improve storability, it may be advisable to add a conventional amount of a polymerisation inhibitor to the monomeric esters of methacrylic acid and/or acrylic acid. Suitable inhibitors include quinone, hydroquinone, tert.butyl pyrocatechol and other phenolic inhibitors.

The invention is illustrated by the following Examples.

EXAMPLE 1

A magnesium pressure casting is cleaned with acetone before processing and dried with compressed air. It is then directly introduced into a container three quarters full of monomeric triethylene glycol dimethacrylate so that it is completely covered by the monomer. After the container has been closed, a reduced pressure of 2 mm Hg is applied for 5 minutes. Under the effect of the reduced pressure applied, the air in the metal pores is drawn through the monomer and in this case only acts as a transfer agent. At the same time, the monomer is also degassed. On completion of the evacuation phase, the reduced pressure is broken by 8 atms. nitrogen excess pressure and the component left in the sealing liquid for another 5 minutes. It is impregnated during this phase. After the excess pressure has been removed and the container opened, the component is removed and left to drip. By virtue of its low viscosity, most of the impregnating monomer drips off. The casting is introduced into a standard commercial washing liquid and moved around in it for 5 minutes. After it has been allowed to drain, the casting is dried with compressed air and introduced into a hardening cabinet. The impregnating monomer introduced is hardened in this cabinet for 1 hour at a temperature of from 50 to 180°C.

EXAMPLE 2

After cleaning, an aluminium casting is introduced into an evacuable container and, after the container has been closed, a reduced pressure of 1 mm Hg is applied. After 5 minutes, monomeric triethylene glycol dimethacrylate is allowed to flow into the container until the casting is completely covered with impregnating liquid. The reduced pressure is then interrupted with nitrogen under an excess pressure of 8 atms., and the casting to be sealed left in the sealing liquid for another 5 minutes. During this phase, the casting is filled with sealing compound. The further procedure is as described in Example 1.

EXAMPLE 3

After cleaning, a magnesium casting is introduced into an evacuable container con-

taining monomeric 1,4-butanediol dimethacrylate, and, after the container has been closed, a reduced pressure of 10 mm Hg is applied. The reduced pressure is interrupted after 15 minutes with nitrogen under an excess pressure of 8 atms. At the end of a 15 minute impregnating phase under excess pressure the metal casting covered with monomeric butanediol dimethacrylate is re-evacuated by applying a reduced pressure of 10 mm Hg for 15 minutes and is then impregnated a second time by again interrupting the reduced pressure with nitrogen under an excess pressure of 8 atms. The casting is then put through the aforementioned cycle for a third time. Further treatment is carried out as described in Example 1.

WHAT WE CLAIM IS:—

1. A process for impregnating and/or sealing metal castings which comprises introducing a liquid monomeric ester of a polyhydric alcohol completely esterified with methacrylic acid or acrylic acid or a mixture of such esters into the pores of the castings and hardening the ester or esters by heating in the absence of a polymerisation catalyst.

2. A process as claimed in Claim 1, wherein the ester is triethylene glycol dimethacrylate.

3. A process as claimed in Claim 1 or 2, wherein the ester contains a polymerisation inhibitor.

4. A process for impregnating and/or sealing metal castings substantially as hereinbefore described with reference to any of the examples.

5. Metal castings when impregnated and/or sealed by a process as claimed in any of claims 1 to 4.

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